Acquiring Evolving Technologies:
Web Services Standards

Harry L. Levinson
Software Engineering Institute
Carnegie Mellon University
Pittsburgh, PA 15213

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Acquiring Evolving Technologies

Purpose: combine ideas from different systems engineering areas into a repeatable process for managing technology assessments

This presentation discusses

- challenges of acquiring Web services
- why assess technology?
- assessing technology appropriateness
- applicability to net-centricity

Although not detailed, this presentation borrows from

- system and software architecture
- business principles
- process improvement
- technology solutions
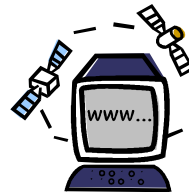- system of systems techniques

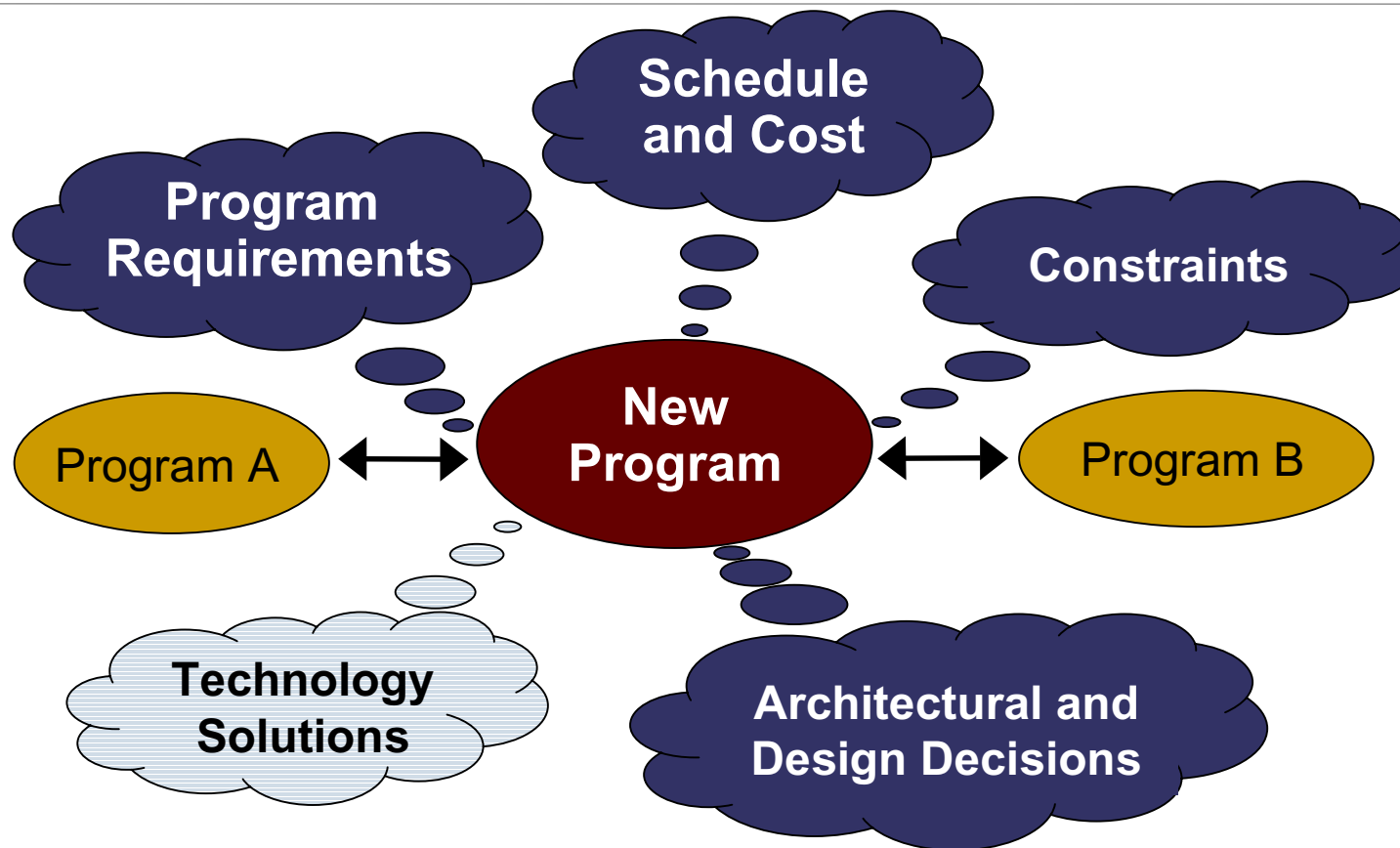# Symbols Used in This Presentation

Concept ?

Example ?

Technology ?

Acquisition Challenges

First, a Notional Program

A **notional program**, Language Translation Services (LTS), helps us explore this topic within a specific context.

LTS Version 1 (2005)

- **Purpose*: translate a paragraph of text from one language to another**

Features

- **anyone in the world can create and/or use a translation service**

- **customization of features (such as accuracy, speed, and dialect) is supported**

LTS Upgrade

LTS Version 2 (2006)

- **Goal*: improve accuracy**

New Features

- **Link up to 10 paragraphs; changes to previous translation responses may be returned**

- **request translations with additional features including domain, linking, and alternate choices when the accuracy of translation is less than 98%**

- **the service must report state changes within 10 seconds (for example, degraded performance)**

LTS Architectural Solution

A service-oriented architecture (SOA) was selected as the architecture for LTS Version 1.

SOAs have been described as

- "SOA is about separation" —CBDI

- "supports integrating your business as linked, repeatable, business tasks"
  —IBM

- "a lifestyle" and "something you do, not something you buy" —Burton Group

Issues with SOAs that we will not discuss today

- organizational and cultural change

- governance

- infrastructure

- adoption techniques

- implementation techniques

SOA and Quality Attributes
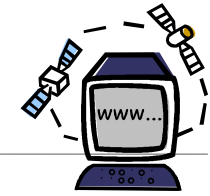
Using an SOA approach impacts the quality attributes in different ways.

Positive Impact	Neutral Impact	Negative Impact
Interoperability	Reliability	Security
Extensibility	Availability	Performance
Adaptability	Scalability	Testability
Modifiability	Usability	Auditability
	Operability and Deployability	

[O'Brien 05] *Quality Attributes and Service-Oriented Architectures* (CMU/SEI-2005-TN-014)

Implementing an SOA Using Web Services Standards
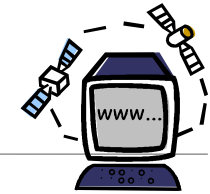
Think of Web services standards (WS-*) as a tool for SOA technology (Burton Group) or standards-based SOA (Sonic).

Launched in the year 2000, arguably

- **six years old; today's hot topic**

  — **adolescent or mature?**

From 50 to 240 specifications

- **open framework with a large number of commercial solutions**

  — **options or confusion?**

Three organizations manage the open standards

- **many companies large and small participating**

  — **cooperating or competing?**

Why Should We Assess Technologies?

Risks related to acquiring technology

- **complexity of implementation**

- **testing challenges**

- **managing change**

  — **neither technology nor programs stand still**

DoD policy requires for Major Defense Acquisition Programs (MDAPs) and Major Acquisition Information Systems (MAIS) programs

- **Technology Readiness Assessment (TRA) per *DoD 5000.2* usually via Technology Readiness Levels (TRLs)**

- **TRLs assign a single number, which especially for software, does not address the many dimensions of readiness assessment.**

Beyond Technology Readiness Levels

Simple, yet meaningful method to assessment

- prototypes or models are meaningful, but difficult and time-consuming to create
- white paper research is not deep enough
- Is there something in between?

Change: a key challenge of assessment

- wait until stable > nothing gets done
- blindly go ahead > everything gets confused
- keep changing the decision > everyone gets confused

Dimensions of the assessment

- ability to meet the requirements
- environmental appropriateness and constraints
- importance to the solution
- lifecycle match [Smith 04]

Processes within the acquisition life cycle must allow decisions to be reevaluated on a regular basis.

[Smith 04] *An Alternative to Technology Readiness Levels for Non-Developmental Item (NDI) Software* (CMU/SEI-2004-TR-013)

Assessing Web Services Standards
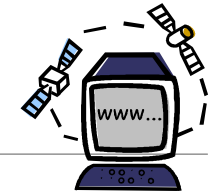
WS-* standards

- How effective is each standard?

- Where is each standard in the process?

- How much effort is being put into developing the standard?

- conflicting and/or competing standards?

- compatibility and certification?

Standards process, W3C, OASIS, WS-I

- Which companies are participating?

- What impact are they having on the process?

Products available

- companies implementing and advertising WS-*?

- tools to develop and manage WS-* solutions?

- market acceptance, availability?

- opinions of external research organizations?

Assessment Dimensions

Assessing a standard's maturity

- **rate of change**

- **number of features**

- **number of features not available**

- **number of implementations available**

Assessing a standard's impact

- **enable, inhibit, or add confusion to system implementation**

- **trade-off decisions to be made**

- **potential changes to standards, how it affects architectural decisions**

Proposed Analysis Method

- **compare the needed system capabilities to SOA quality attributes**

- **match them with the appropriate Web service standards and**

- **assess the WS-* *maturity* and *impact* on the system**

Initial Analysis of LTS Version 1

LTS Capabilities	SOA Quality Attributes (SEI Technical Note)	Web Services Maturity and Impact (Authors' Analysis)
Add New Services	Interoperability(+) Availability(.)	WS-Discovery(-) WS-BPEL(.) UDDI(+)
World-Wide, Multiple Services	Extensibility(+) Scalability(.) Performance(-)	WSDL(+) ASAP(-) WS-Transfer(.)
Assorted Functionality	Adaptability(+) Modifiability(+)	WS-Coordination(-) WS-Context(-)
World-Wide, Multiple Users	Interoperability(+) Availability(.)	WS-Trust(-) UDDI(+)

Combining maturity & impact blurs meaning of each dimension

Quality attributes and Web service standards are associated with multiple capabilities

Items that have positive, negative, minimal, plus varied maturity and impact are associated with a single capability

Improved Analysis for LTS Version 1

WS Standard: Web Services Security (WS-Security)
Organization: OASIS, Ver: 1.0 3/04

	Impact	Maturity
Adaptability	Minimal	Mature
	Not key QA	Widely implemented
Auditability	Negative	Adolescent
	More information needs to be audited	As auditing is addressed better, changes might happen
Availability	Minimal	Mature
	Establish secure communication but no guarantee of service failure	Widely implemented
Extensibility	Positive	Mature
	Security messages are extensible and additional fields can be added	Widely implemented
Interoperability	Positive	Mature
	Allows for loose or tightly coupled systems, requires policies to be well defined	Widely implemented
Modifiability	Positive	Mature
	Underlying service can change without change in message	Widely implemented
Operability and Deployability	Minimal	Mature
	Not key QA	Widely implemented
Performance	Negative	Adolescent
	Additional message and increased size	Always looking for ways to improve performance
Reliability	Positive	Mature
	Establish secure communication	Widely implemented
Scalability	Minimal	Mature
	Not key QA	Widely implemented
Security	Positive	Adolescent
	Built for confidential message transmission	Although widely implemented, this key QA may be affected
Testability	Negative	Adolescent
	More messages and scenarios to be tested	As testing is addressed better, changes might happen
Usability	Minimal	Mature
	Not key QA	Widely implemented

Impact Average: 0.15   **Maturity Average:** 0.69

(callout) Use SOA quality attributes to help tradeoff decisions

(callout) Roll up analysis into a single number for quick comparisons

(callout) Separate dimensions for more accurate analysis

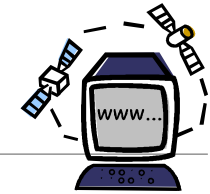*(callout)* Color coding for quick analysis. Include comments to capture reasoning

Comparison of Select Standards

Standard	Impact (2005)	Impact (2006)	Maturity (2005)	Maturity (2006)
SOAP	0.15	0.15	0.77	0.85
WSDL	0.23	0.38	0.69	0.31
UDDI	0.38	0.38	0.62	0.62
WS-Security	0.15	0.15	0.69	0.54
WS-BPEL	0.08	0.23	-0.31	-0.62
WS-Transfer	0.00	0.00	-0.15	0.08
WS-Trust	0.00	0.00	-0.54	-0.54
WS-Coordination	0.23	0.23	0.69	-0.54
WS-Context	0.15	0.31	-1.00	-0.15
WS-Discovery	0.15	0.15	-1.00	-1.00

-1	0	1	-1	0	1
Negative	Minimal	Positive	Immature	Adolescent	Mature

Net-Centric Acquisition Challenges

Operational

- **implement capability using varied and distributed systems**

Interoperable

- **address system-of-system issues, such as emergent properties**

Evolution

- **handle changes in technology while keeping the program operational and interoperable**

SOAs and Web services standards are a natural fit for net-centric solutions because of their positive quality attributes. However, they bring with them negative attributes that complicate implementation.

LTS Assessment, Including Net-Centric Objectives[1]

| LTS Capabilities	Version	SOA Quality Attributes (SEI Technical Note)	Web Services Maturity and Impact (Authors' Analysis)	NESI Enterprise Technology Objectives
Add New Services	Version 1	Interoperability(+) Availability(.)	WS-Discovery(-) WS-BPEL(.) UDDI(+)	Capability On Demand
World-Wide, Multiple Services	Version 1	Extensibility(+) Scalability(.) Performance(-)	WSDL(+) ASAP(-) WS-Transfer(.)	Distributed Operations
Assorted Functionality	Version 1	Adaptability(+) Modifiability(+)	WS-Coordination(-) WS-Context(-)	Customized Applications
World-Wide, Multiple Users	Version 1	Interoperability(+) Availability(.)	WS-Trust(-) UDDI(+)	Multi-user Access

LTS Assessment, Including Net-Centric Objectives[2]

LTS Capabilities	Version	SOA Quality Attributes (SEI Technical Note)	Web Services Maturity and Impact (Authors' Analysis)	NESI Enterprise Technology Objectives
Linking and Dialects	Version 2	Adaptability(+) Operability and Deployability(.)	WS-BPEL(.) WS-Policy(-)	Customized Delivery
Auditing and Security	Future	Auditability(-) Reliability(.) Security(-)	WS-Policy(-) WS-Security(-) WS-Trust(-)	Assured Sharing
New Features	Version 2	Testability(-) Extensibility(+)	WS-Policy(-) WS-BPEL(.) UDDI(+)	Incremental Upgrade
Share Translations	Future	Usability(-) Performance(-)	SOAP(+) WS-Reliability(-)	Data Exchange

Summary
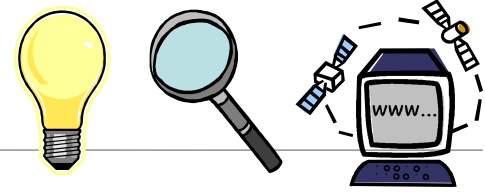
We need a method to systematically assess the appropriateness of evolving technologies.

- **Technologies change frequently, therefore the decisions based on technology should be reviewed regularly.**

Quality attributes constitute a key dimension of technology assessments.

- **For the LTS example, we assessed the *impact* and *maturity* dimensions.**

Assess Web services standards regularly to reduce risk.

- **Apply this assessment tool and the associated process to start, then tailor each to meet programs' needs.**

For More Information

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Harry L. Levinson
Liam O'Brien

Technical Note
CMU/SEI-2006-TN-001

http://www.sei.cmu.edu/publications/documents/06.reports/06tn001.html

Contact Information

Harry L. Levinson

Software Engineering Institute

Carnegie Mellon University

Pittsburgh, PA 15213

412-268-4148

hll@sei.cmu.edu

Acquisition Support Program

http://www.sei.cmu.edu/programs/acquisition-support/